Racial Implications of Metropolitan Land Use Regulation

By BRANDON WONG *

Recent work has explored the dynamics of segregation and the impacts that city planning can have on it. Restrictive zoning and other regulations may decrease the available housing to minorities and therefore serve to increase racial segregation, despite being nominally race-blind. I exploit variation in land use regulations generated by natural differences in geography as an instrument for land use regulation stringency and understand its relationship to investigate whether restrictive land use regulation increases segregation. The results of analysis, while inconclusive, indicate land use regulation may have a sizable effect on urban segregation, but more exploration is needed. *Keywords: Land Use, Segregation, Geography, Urban*

Throughout mainstream US political discourse, housing prices relative to incomes has become a topic of growing importance, especially with regards to social equity in urban development. Many conversations revolving around an "affordability crisis" have arisen. These particularly tend to focus on high demand coastal areas and larger cities (Glaeser, Gyourko and Saks, 2005). Throughout the 2020 Presidential Campaign many candidates bemoaned the high prices in places such as New York City and San Francisco, citing advocacy and policy groups concerned especially with increases in real housing prices since the 1970s[1]. Understanding the causes of increasing housing prices and the impli-

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cations that they have on social outcomes is of great concern to economists. For example, restrictive housing prices may lead to labor immobility resulting in increasing income inequality (Ganong and Shoag, 2017; Albouy, Ehrlich and Liu, 2016), decreasing productivity growth (Hsieh and Moretti, 2019), and even ecological damage (Johnson, 2001). It is hypothesized by some that increasing distortions in the housing markets have contributed to "secular stagnation" (Summers, 2014). A lively debate surrounding how to alleviate this problem has grown with cities like San Francisco enacting rent control policies, while groups of individuals have banded together to get YIMBY ("Yes In My BackYard") policies passed[2]. Recent work like Mast (2019), Glaeser and Gyourko (2002), and Glaeser and Ward (2006) paint a picture that restrictive land use regulation and artificially low supply are the primary driver of high housing prices. However, in order to properly evaluate urban developmental policy, it is crucial to understand which group of people are being affected and how they are.

This is a topic of growing interest within the Urban Economics field as new papers begin to investigate the effects of urban segregation on outcomes. There is a large breadth of literature that finds strong negative effects from periods of racial segregation that may increase poverty (Cutler, Glaeser and Vigdor, 2007), crime (Chetty and Hendren, 2018), or reduce intergenerational wealth (Ananat, 2011). Given racially motivated urban policies[3] such as redlining in the 20th century, one of the continuing goals of urban planing has been to target historical segregation, paying special attention to black-white segregation. However, very little research serves to contextualize land use policy and its causes. Saiz (2010)

[1]Selected headlines include "Top 2020 candidates release housing affordability plans" (NBC News), "Will Housing Swing the 2020 Election?" (Bloomberg), and "How the Democratic Candidates Would Tackle the Housing Crisis"

[2]YIMBY is a play on the development sentiment known as Not In My BackYard which aims to reduce development. See, for example, Fischel (2001)

proposes that geographic constraints to elasticity directly contribute to land use regulations being enacted while Trounstine (2020) draws a political theory of racially motivated land use regulations for the purposes of segregating communities which she demonstrates using Fair Use Housing Act lawsuits. Papers like Rothwell and Massey (2009), Shertzer, Twinam and Walsh (2021), and Caetano and Macartney (2020) also suggest that land use regulations may be responsible for increased racial segregation. This paper serves to try and bridge the gap in the literature about the links between land use regulations and levels of segregation.

I develop a framework for estimating the contemporaneous effects that land use regulations have on racial segregation levels driven by geographic development restrictions. Using geographic information systems (GIS) data, I first show that geography is a significant predictor of land use regulations as shown in Saiz (2010). Specifically I aim to answer whether more restrictive land use regulation increase metropolitan segregation levels between black and white households. Then I link the segregation measurements to land use regulation through geography as an exogenous source of variation in segregation outcomes to provide the statistical significance of my results. I will be using a dataset constructed of multiple measures of segregation created using decennial census data, 1990 geographic measurements and a land use index. I consider a two-stage least squares (2SLS) model where I use geography as a plausibly exogenous predictor of land use regulation to assess my hypothesis.

[3] Santucci (2019) provides an excellent example of racial covenant acting as a strong barrier barring black households from entering white neighborhoods

I. Segregation, Geography, and Measurement

A. Segregation

In the context of this paper, segregation is a a systemic racial division of citizens into differing metropolitan neighborhoods and homes. Concentrations of racial groups are not uncommon in many large metropolitan areas and are sometimes a preferred community, but segregation is generally caused through policy choices that are deliberate or not. Segregation can also be further exacerbated and enforced through non-policy mechanisms such as restrictive prices, occupational licensing, and historic districting. Because segregation is complex and there are a variety of facets that all require different measurements; it is necessary to look at multiple indices when attempting to understand segregation levels. There are a variety of measures that economists typically use to evaluate spatial segregation. These usually come in the form of various indices that are calculated by Census tract data and demographic information. Such indices provide a very rough estimate of racial homogeneity across an area rather than a within-place neighborhood segregation measure like more sophisticated indices such as those produced in Logan and Parman (2015). Given the size of the cities that I am examining, I opt for a widely used segregation index.

In this paper, two common measures of segregation will be used constructed by economists who have previously studied the relationship between urban development and demography (Cutler and Glaeser, 1997). Isolation is primarily defined by minority group exposure to a majority group, in this case black exposure to white households. For instance if all predominantly black neighborhoods are clustered in one area of the metropolitan area, isolation is higher as there is a lack of exposure to white neighborhoods. Measuring the propensity for contact with majority groups allow us to develop a picture of the racial distribution of households within a metropolitan area. Isolation is the ratio of populated areas normalized from 0 to 1 with 0 indicating perfectly even distribution of minority groups with 1 indicating minority groups having no exposure to majority groups[4]. Following is the methodology for calculating the index using black and white populations:

$$\text{(1)} \qquad Isolation = \frac{\sum_{i=1}^{n} \left(\frac{black_i}{black}\right)\left(\frac{black_i}{total_i}\right) - \left(\frac{black}{total}\right)}{\min\left\{\left(\frac{black}{total_i}\right), 1\right\} - \left(\frac{black}{total}\right)}$$

While isolation is useful for measuring absolute relative population, dissimilarity helps to develop a picture of homogeneity of neighborhoods. Using a dissimilarity index, more diverse households within a given tract is considered less segregated. If, for example, there is an entirely black neighborhood, next to an entirely white neighborhood, next to an entirely Hispanic neighborhood, this tract would have a higher dissimilarity index regardless of the population levels of each corresponding groups. Dissimilarity us a good complement to isolation by moving to relative magnitudes in a population rather than a relative distribution. Similar to isolation, dissimilarity is normalized on a scale from 0 to 1. Following is the methodology for calculating the index using black and white populations:

$$\text{(2)} \qquad Dissimilarity = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{black_i}{black} - \frac{non\text{-}black_i}{non-black}\right|$$

For all calculations i is the unit area of interest, in this case neighborhoods, with

[4]In this paper, highly isolated is greater than .6, moderately isolated is from .3 to .6, and low isolation is less than .3. These same buckets apply for the dissimilarity index following.

black, white, non-black, being the number of the corresponding race within the population of the area examined. For a more intuitive view of each of the indices used, refer to Figures 7 and 8 for images taken from Weinberg and Steinmetz (2002). It should be clear that both of these two segregation indices tend to correlate relatively strongly with each other as shown in Figure 1. However, many cities that have a low isolation index, may actually end up having very uneven distribution which still makes them relatively segregated. For example, San Francisco in 1990 had an isolation index of .2638 but a much higher dissimilarity score of .5771.

B. Geography

Importantly, over short to medium time horizons, geography is a statistically significant predictor of land use regulations, which I will be measuring using the Wharton Residential Land Use Regulation Index (WRLURI) from Gyourko, Hartley and Krimmel (2019). This index is normalized with a mean of 0 and a standard deviation of 1 with higher values indicating higher levels of regulation. One pitfall of this index is that it does not describe the type of regulation that each MSA has, in fact, the most highly regulated areas using this metric tend to have multiple dimensions of regulation in land use. The index combines local political pressure, state involvement, court involvement, rates of approval, and other forms of regulatory pressures.

Geographic data will come from Saiz (2010) using GIS software to gather information on baseline development guidelines that create geographic constraints on urban sprawl. To begin, I generally am most interested in dense urban areas and my sample constains MSAs with populations greater than 50000 residents. While this does decrease my sample size down to around 300 metropolitan areas, it allows for a narrower view of segregation dynamics. It also happens to be the case that larger cities will have more heterogeneity in land use regulations, allowing us to get more significant results as seen in Figure 2. Once I have my list of MSAs I have measures of developable area using the GIS data.

Typical real estate guidelines restrict development in areas with elevation increases greater than 15% per 50 kilometre (km) radii. As the 50 km distance is a simple radii for the rest of the geographic measurements, all other arcGIS data including percentage of area that is water will be based around this value. The rest of the geography data is structured around the Land Area Baseline as a percentage of each 50 km radii that is non-ocean. Land area that cannot be developed on will be subtracted from this value including wooded, herbaceous, and emergent wetlands. Following is the methodology for calculating the land unavailable for development:

$$Unavailable = 1 - \left[\left(\frac{Flat\ Area_i}{100} - \gamma_i \right) \left(\frac{Land\ Area\ Baseline}{100} \right) \right] \tag{3}$$

Where γ_i the sum of area that is Open Water, Wooded Wetlands, and Emergent Wetlands. All this combines to develop a picture of metropolitan geography unavailable for development to used in estimation of housing supply elasticity using exogenous features.

II. Empirical Methodology and Summary Statistics

Upon combining the segregation and geographic data sets, we are left with 229 cities assigned by Metropolitan Statistical Area code. There is quite a long right-hand tail of the population sizes in 1990 of each of the cities with many of them having 800,000 or more citizens. Interestingly, the WRLURI follows a very similar distribution which corresponds with the claim that land use regulations are strongly tied to geographic constraints on development. There are shown in Figures and with relevant statistics reported in Table 1. The WRLURI shows a very illuminating pattern about large cities. The mean was -.1591 which puts them well below the bottom quartile of regulation based on the WRLURI's construction of 0 as the mean. This means that, in general, big cities tend to be more restrictive than the rest of the areas included in the total WRLURI data. However, we also see great heterogeneity in city regulation with some cities reaching the top 1% in regulatory slack, which is indicated by the large standard deviation. Geographically, the cities in the US are even more heterogeneous with a strong skew towards being developable. The mean city has about 25% of land unavailable for development with a standard deviation of approximately 21%. However, the most common values were trivially close to 0 which indicates that the majority of cities are not extremely geographically constrained.

With respect to segregation, I matched the 1990 population data with the same years' segregation indices. I also included 1950s segregation indices for comparison, although there are far fewer reported observations. It is worth noting that the mean isolation level in 1990 observed was .2829 with dissimilarity much higher at .5741. This corroborates with the idea that cities which may still have relatively diverse populations siphon households into specific neighborhoods. Besides the observations that have them close to 0, both of the distributions of the segregation indices appear relatively normally distributed, albeing with differing means. In accordance with Saiz (2010), as elasticity goes up, the WRLURI goes down.

To estimate the connection between land use regulation and segregation I adopt the following reduced form model:

$$Segregation = \beta_0 + \beta_1 USE_i + \beta_2 \pi_i + \beta_3 X_i + \varepsilon_i \tag{4}$$

Where *USE* is our land use measurement for each MSA, i. π_i is an elasticity value for each corresponding MSA and X_i are a population controls. In a final regression, I include a control for 1950s segregation which shows that past segregation is a statistically significant. However, due to the lack of data having both 1990 isolation and 1950 isolation leaves us with only 53 observations making any inferences impossible due to possibly spurious results. Then my 2SLS model uses the following first-stage equation:

$$USE_i = \alpha_0 + \alpha_1 UNAVAIL_i + \alpha_2 \pi_i + \beta_3 X_i + \varepsilon_i \tag{5}$$

Where *UNAVAIL* denotes the percentage of land that is unavailable for development as outlined in equation (3) and the rest of the estimators are the same as in equation (4). All observations are weighted by MSA population. As a discussion about the validity of using geography as an instrument, Davidoff (2016) is of importance here. Critically, Davidoff argues that building costs associated with physically constrained development are not a strong supply constraint, making geography an invalid instrument for home prices. However, this model uses physical constraints as an instrument for zoning rather than physical supply and building. This implies that demand can only be met by building at the suburban fringe rather than throughout the metropolitan area. Since it has already been shown that geography is a robust predictor for zoning we include supply in the form of elasticity in the right hand side of our estimating equation.

III. Results and Conclusions

All forms of the 2SLS regressions are reported in Table 2 with every column first showing effects on isolation, then for dissimilarity. The results of my first two models indicate that land use has a relatively large effect on both isolation and dissimilarity. However, these results are not statistically significant with reported p-values just missing the 90% confidence level[4]. It is likely that this is due to the low number of observations in my dataset that result in relatively high standard errors. Since the confidence interval is large, it is impossible to reject the null hypothesis. However, these results are helpful to understand the direction and magnitude of the effect. I see that, on average, the marginal effect of an increase in land use regulation has increases the isolation index by 0.07419. Since the index goes from 0-1, this is quite a large effect moving many cities from a lower quintile to the next of regulatory burden. These results also show much smaller increase for dissimilarity of 0.0234568, which is likely a result of the mean dissimilarity of urban areas being quite high to begin with. Importantly, the population estimates are functionally equivalent to 0. This indicates that for the cities, the effects of land use regulation on segregation levels is not dependent on the size of the city.

My second regression results reports in Table 3 only contain results on isolation. The first columns includes the effects of earlier segregation on the right hand side. It brings the coefficient on land use within a 90% confidence interval despite also dramatically decreases the size of it. Because the observations have also decreased, it is difficult to understand how including this effect would shape our overall structural model. I also include regressions with observations weighted by population size rather then including them as a fixed effect. Here we see statistically significant effects that are even larger. This suggests that there my initial results may still carry information about the effects on segregation There are also included threats to validity of my analysis which may result from omitted variable bias. More specifically, I would have liked to have access to

[4]My reported p-values for the first two models are .149 and .174 respectively

neighborhood socioeconomic demographic data, average building height or lot size, and other neighborhood level variables that may have given more insight into the specific makeup and migration patterns of the neighborhoods. However, due to privacy concerns, these are not provided.

The results of this analysis are inconclusive given the statistical significance of my estimators. However, this is likely a result of the relatively low number of cities accounted for since these were the only ones that I had geography data on. This selection effect means that I am only accounting for cities who have both been geographically examined and had a relevant segregation index calculated for. Despite these issues present in the data, We can interpret the preliminary findings to be similar to what other studies have found regarding land use policy and its effects on demographic change which still makes it informative. There is a strong suggestion that more restrictive land use policies within metropolitan areas may serve to increase segregation within those areas. Further research into the nature of this relationship should be conducted using more data as the spatial inferences from this paper may not encapsulate all dynamics that result from regulation and movement.

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IV. Tables and Figures

TABLE 1—SELECTED SUMMARY STATISTICS

	mean	sd	min	max	count
Population	834930.1	1303451	57661	9546597	229
Unavailable	.2507299	.2126945	.0045698	.8601149	229
Housing Supply Elasticity	2.544065	1.465981	.5952661	12.14801	229
WRLURI	-.159097	.7602786	-1.764706	3.121081	229
Isolation, 1990	.282945	.1920674	.0053978	.7625341	228
Dissimilarity, 1990	.5741036	.127768	.2659263	.8727628	228
Observations	229				

TABLE 2—IV REGRESSION RESULTS, 1990

	(1) OLS	(2) OLS	(3) First Stage	(4) Second Stage	(5) Second Stage
Housing Supply Elasticity	0.0103	-0.00131	-0.625***	0.0517*	0.0217
	(0.0211)	(0.0133)	(0.0890)	(0.0291)	(0.0190)
ln(Population)	0.141	-0.0126	-1.188	0.173	0.00544
	(0.376)	(0.201)	(0.802)	(0.232)	(0.152)
ln(Population)^2	-0.00128	0.00228	0.0392	-0.00247	0.00162
	(0.0137)	(0.00728)	(0.0287)	(0.00816)	(0.00534)
WRLURI	-0.0759**	-0.0448**		0.0373	0.0181
	(0.0378)	(0.0224)		(0.0701)	(0.0459)
Share Unavailable for Development; 50km Radius			-1.359***		
			(0.446)		
Constant	-1.368	0.346	10.54*	-1.674	0.176
	(2.577)	(1.384)	(5.687)	(1.646)	(1.077)
Observations	228	228	229	228	228
R^2	0.291	0.201	0.441	0.209	0.137
Adjusted R^2	0.278	0.187	0.431	0.195	0.121

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE 3—ADDITIONAL IV REGRESSION RESULTS, 1990

	(1) Including 1950 Isolation
WRLURI	0.415
	(0.299)
Housing Supply Elasticity	0.127
	(0.129)
ln(Population)	-0.338
	(1.181)
ln(Population)^2	0.00950
	(0.0411)
Isolation, 1950	0.978***
	(0.317)
Constant	2.581
	(8.445)
Observations	53
R^2	.
Adjusted R^2	.

Standard errors in parentheses
Standard errors are clustered
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

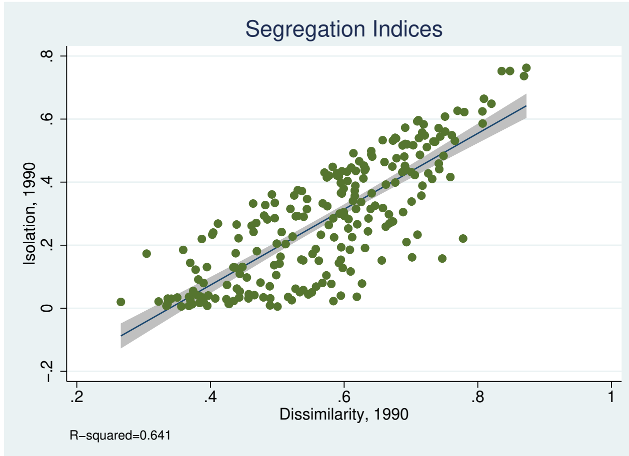

Figure 1. Relationship between indices

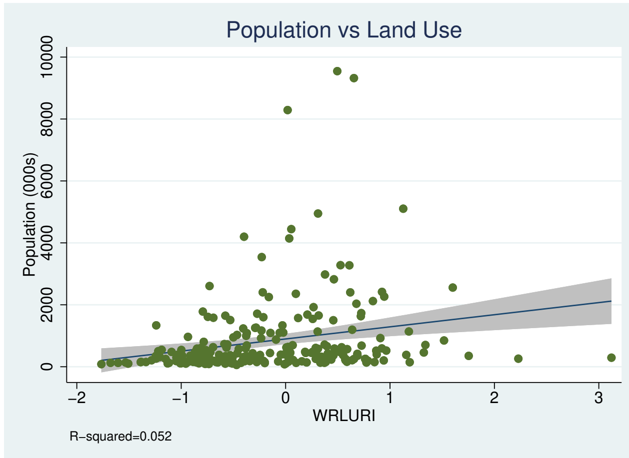

FIGURE 2.

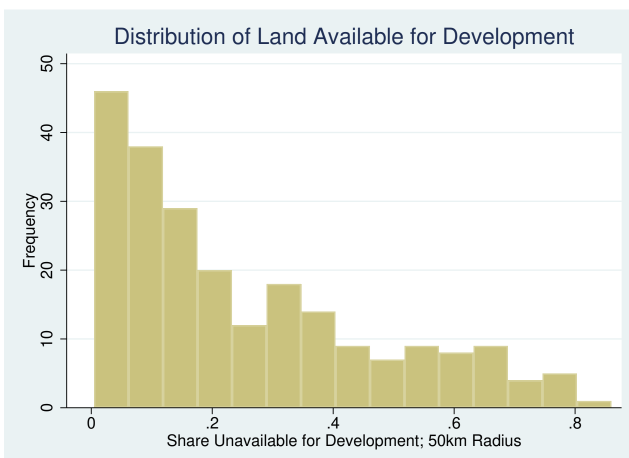

FIGURE 3.

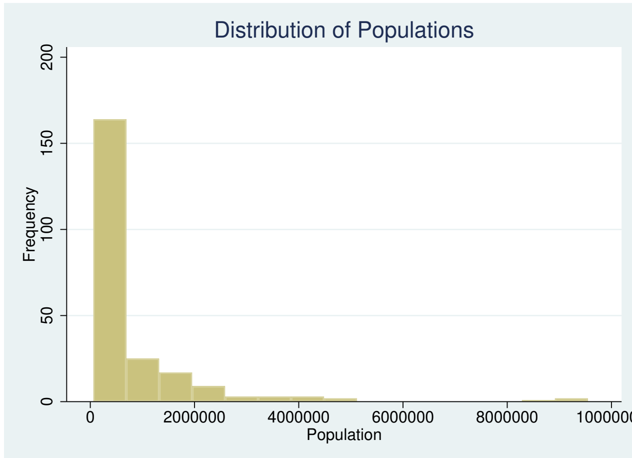

FIGURE 4.

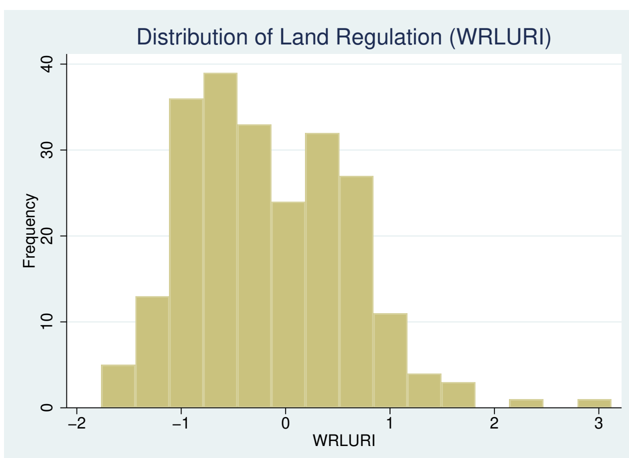

FIGURE 5.

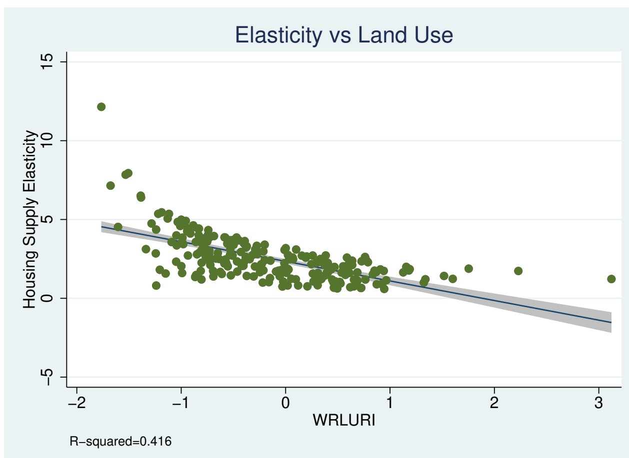
Elasticity vs Land Use
Housing Supply Elasticity
−5
0
5
10
15
−2
−1
0
1
2
3
WRLURI
R−squared=0.416

FIGURE 6.

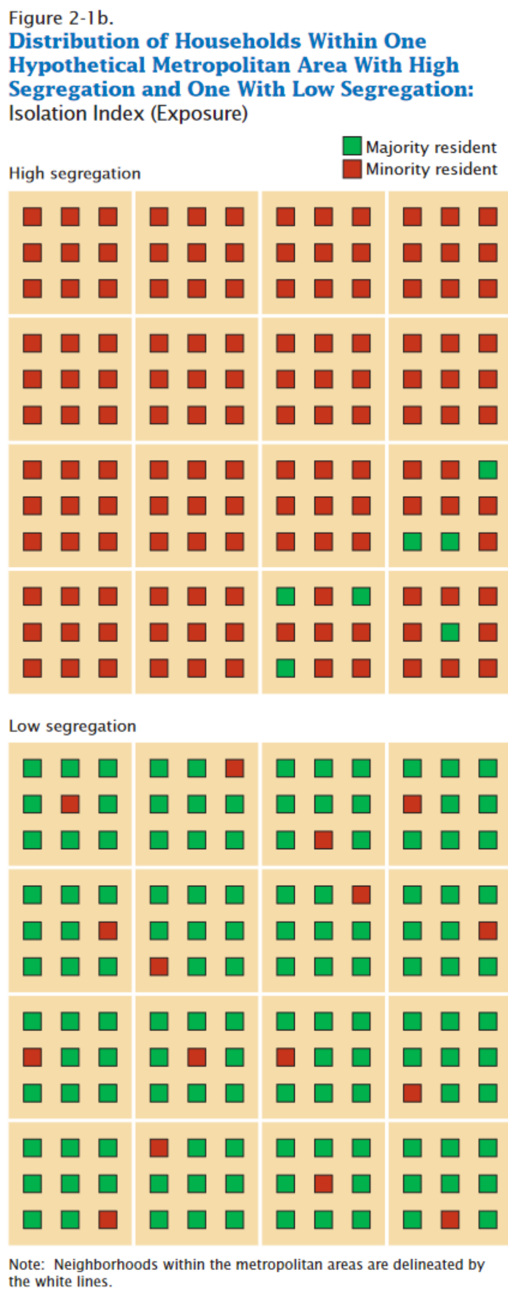

FIGURE 7. SOURCE: WEINBERG AND STEINMETZ (2002)

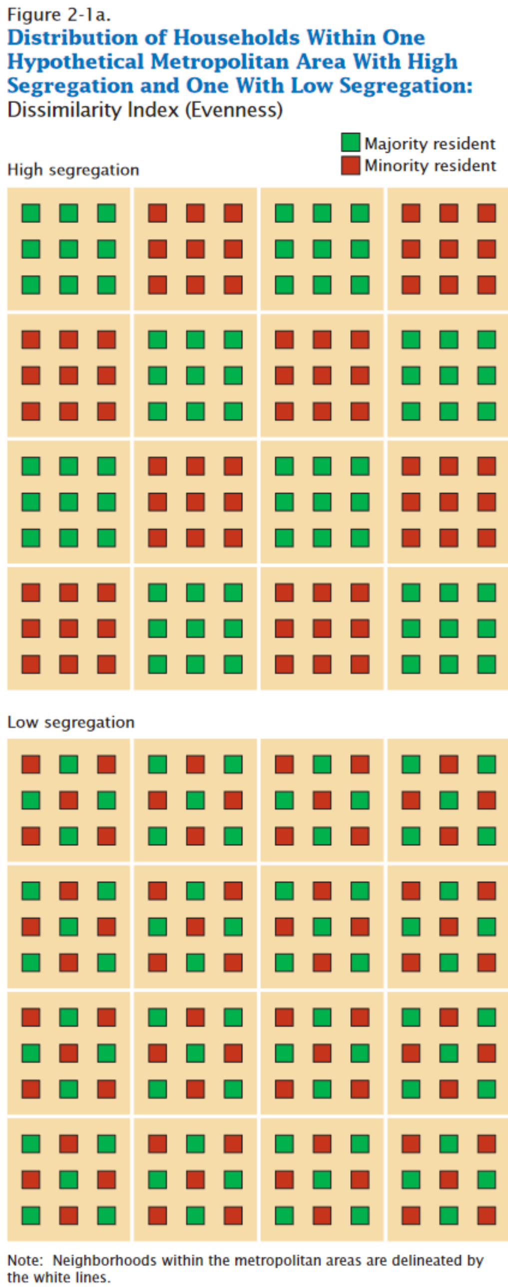

FIGURE 8. SOURCE: WEINBERG AND STEINMETZ (2002)